the Dark Argus in Mr. Humphrey's book; so would you kindly inform me whether this is a new locality, and whether there are two broods, the first in May and the second in July, as is the case with several of family, as would appear from the above statements? I identify the species with his Dark Argus by the following peculiarities, viz.: (1) an obscure black spot near centre of fore-wings; (2) *no* black spots in the orange ocelli in fore-wings, the hind-wings containing these black spots as in the Brown Argus. JOHN HODGKIN, JUN.

West Derby, near Liverpool

Meteorological Phenomenon

WHILE walking out yesterday afternoon my attention was drawn to a very remarkable display of mares-tail clouds spreading from the north, stretching in broad and narrow bands in every direction over the whole sky, and reaching beyond the zenith. While standing thus facing the sun, I saw, at a great elevation, a coloured bow with its convex red side towards the sun; it was only about one-sixth or one-seventh of a circle, and its width seemed to be only about half that of an average ordinary rainbow. It had the appearance of being nearly horizontal, with its centre not far from the zenith, but probably not so distant. Not being accustomed to estimate elevations, when I got home I took a quadrant and held it about the elevation of the part of the bow nearest the sun, and found it came out, on repeated trials, at a *zenith distance* of 25° or 26°.* When I first saw the bow it was just 6h. 30m. P.M. Greenwich time, and the sun appeared to be about 15° above the horizon (that you can correct by calculation). The sun was shining brightly, and the bow was projected over a patch of sky slightly dimmed, at a great height (but below the cirri?), by a smoke-grey haze; its ends just projected over the edges of the clouds. It lasted about 2m. and then faded away. There was no halo or ring but this. The wind was a rather fresh breeze, between S.S.E. and S.

Norwich, June 28 HENRY NORTON

* Subtended at my eye by bow and sun = about 50°?

OUR ASTRONOMICAL COLUMN

SÛFI'S DESCRIPTION OF THE FIXED STARS.—The author of the ancient Uranometria to which we adverted last week, Abd-al-Rahman al-Sûfi (an abbreviation of a much longer name), was born in 903; he was of the sect of the Sûfis, and of Rai, a place to the east of Teheran. He was in high favour with Adhad al-Davlat, of the reigning family of Persia, and it was principally for the instruction of this prince that he wrote the work under notice, which was not the only one he produced. Ibn Jounis reports that he was not only an observer, but framed astronomical tables; and Dr. Schjellerup states he is known to have undertaken geodetic operations. He is said to have determined the length of the year, and in his tables fixes the mean motion of the sun in the Persian year at 359° 45′ 40″·2. He died in May 986. The prince Adhad al-Davlat, who gave great encouragement to the study of the sciences, commenced his reign in 949, and at the time of his death, in 983, governed the extent of country situate between the Caspian and the Persian Gulf.

The translation of the "Description of the Fixed Stars" by Sûfi was made by Dr. Schjellerup from a manuscript preserved in the Royal Library at Copenhagen, which came into the possession of Niebuhr in 1763. It is a copy made in 1601 from a manuscript transcribed in 1013, and, as stated by Schjellerup, "directement d'après l'exemplaire de Sûfi." The translation was finished when the Danish astronomer, through Herr Dorn, had the opportunity of consulting another copy of Sûfi's work, recently acquired by the Imperial Library of St. Petersburg. Where differences exist between the two authorities, they are particularised in notes to Schjellerup's translation.

The description of the stars by Sûfi, though founded upon that of Ptolemy, is not merely a simple translation. All the stars contained in Ptolemy's catalogue were sought in the positions there recorded, and submitted to attentive examination, and their magnitudes carefully noted, as is distinctly stated by Sûfi in his preface. Schjellerup draws attention to the great extent of his work, the perseverance displayed, and the minute accuracy and scientific criticism with which the whole is executed; so that, under all circumstances, the Persian astronomer has presented us with the state of the sidereal heavens in his time, which merits the highest confidence, and which during nine centuries remains without a rival, not having found its equal till the appearance of the "Uranometria Nova" of Argelander.

Prefixed to the description of the constellations, Schjellerup has published what he terms "Tableau synoptique de l'intensité lumineuse des étoiles principales selon Ptolémée (ou Hipparch), Sûfi et Argelander," which is obviously a valuable compilation, and one that may be frequently consulted in cases where the naked-eye stars are suspected of variability. The magnitudes attributed to Ptolemy are not those given in our editions of the "Almagest," but are taken from the work of Sûfi; indeed, Schjellerup considers the former "parfaitement inutiles," being expressed in round numbers and with much confusion, so that in this respect also we have an important addition to our knowledge of the magnitudes of the stars.

In Sûfi's tables of positions, the longitudes of the Almagest are increased 12° 42′, the latitudes being unaltered.

Generally speaking, there is a fair agreement between the magnitudes of Ptolemy and Argelander, the differences not often exceeding a degree of the scale. Amongst the larger discordances Schjellerup points to the cases of 25 Orionis and ρ Eridani, estimated by Ptolemy of the third and fourth magnitudes respectively, while by Argelander they are called a bright fifth and a sixth. Sûfi's estimates in the middle of the tenth century are intermediate, the first star being rated a fourth and the second a fifth magnitude. The case of Sirius is worthy of attention for another reason. Cicero, Horace, and other classical writers refer to the ruddy colour of this star. In the editions of Ptolemy it is indicated as ὑπόκιῤῥος, but Sûfi makes no mention of this reddish tinge, though, as was stated last week, other stars well marked as red stars in our own day, are also so distinguished in his description of the heavens. Instead of reading with Halma καὶ ὑπόκιῤῥος, Schjellerup thinks we should more correctly read καὶ σείριος, conformable to the designations which Ptolemy gives to the other bright stars which bear a proper name, as with α Bootis (ἀρκτοῦρος), α Leonis (βασιλίσκος), &c.; and remarks that it is certain Cicero was the first who mentions the ruddiness of Sirius, that Horace followed him, and that after Seneca we find no reference to it. Eratosthenes, Aratus, Manilius, Hyginus, and Germanicus are silent as to this particularity of the star.

The great nebula in Andromeda is named by Sûfi as an object generally known in the heavens, and it is interesting to note that he also records the variable star recently detected by Herr Julius Schmidt near α Virginis. Its position is very clearly described.

The title of Schjellerup's translation is "Description des Étoiles Fixes, composée au milieu du dixième siècle de notre ère, par l'Astronome Persan Abd-al-Rahman al-Sûfi, par H. C. F. C. Schjellerup, St. Petersbourg, 1874." It was presented to the Imperial Academy in June 1870.

SOLAR RADIATION AND SUN-SPOTS

SINCE I communicated to NATURE the first results (vol. xii. p. 147) of an examination of the Indian registers of solar-radiation temperatures, I have examined some other registers, all of which confirm the conclusion adumbrated in my former note. Among these the most interesting and striking is the hill station Darjiling, in Sikkim, nearly 7,000 feet above the sea. The place is very cloudy, being on the outer Himalayan range, and much

exposed to the moist southerly winds, but it has two advantages over the stations in the plains, viz., that there are nearly 7,000 feet less atmosphere above it, and it is free from the dust haze, so prevalent on the plains, which perhaps more than water vapour (if not thickly condensed) stops a large part of the solar radiation. On clear days and in intervals between the clouds, the sun's heat is sometimes very intense. The table that follows has been compiled in a different manner from that which I communicated a fortnight since. Instead of picking out days with little or no cloud (which are sure enough during the greater part of the year), I have taken the three highest recorded sun-temperatures in each half-month, and from these have deducted the maximum air-temperatures recorded on the same days; the mean of the six observations being taken to represent the month. The same instrument has been in use since the observations were commenced in April 1870. I must leave it to meteorologists at home to compare these temperatures with the recorded sun-spot areas, which I am unable to ascertain. But the maximum radiation temperature evidently falls in 1871, the year of maximum spots, and the increase on that of the imperfect year 1870, and the fall in the subsequent years, at least up to the end of 1874, are very marked.

Mean differences of the three highest solar temperatures in each half-month and the corresponding maximum air temperatures at Darjiling.

	1870.	1871.	1872.	1873.	1874.	1875.
January	—	57·8	67·7	59·2	57·8	62·3
February	—	62·2	62·8	62·3	56·5	60·3
March	—	63·3	63·5	62	58·2	57·8
April	—	64·2	63·2	62·8	55·7	60·2
May	62·2	67·8	66·8	63·8	57·8	—
June	67	68	67·3	62·5	59·2	—
July	63·3	66·2	65·7	60·8	56·3	—
August	70·8	65·7	66·8	60	57·8	—
September	71·5	69·3	63·7	62·3	59·3	—
October	65·5	68·2	70	63·3	60·8	—
November	62·5	67·3	62·5	57·3	63·3	—
December	59	66·3	59	53·8	60·5	—
Yearly means	—	65·5	64·9	60·8	58·6	—

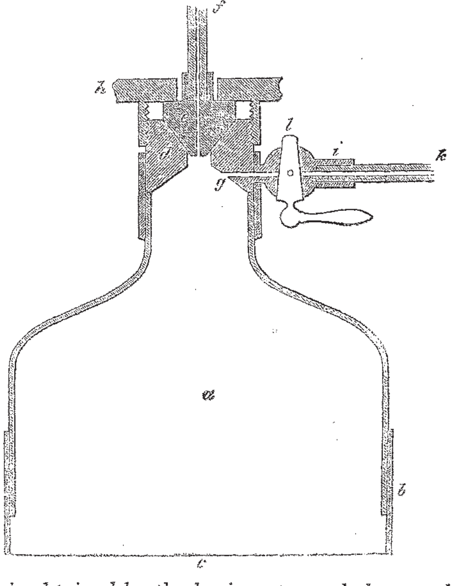
In my former note I adverted to Prof. Köppen's results on the variation of the temperature of the lower atmosphere in the tropics, which he showed to be inversely as the number of the sun-spots or nearly so, from 1820 to 1858. On thinking the matter over, this result, however anomalous at first sight, appears to me really only in conformity with what might be expected when taken in connection with the facts of the rainfall. Since three-fourths of the earth's surface are covered with water, the chief effect of increased radiation must necessarily be to increase the evaporation, and therefore the cloud and rainfall. The former of these will intercept a larger proportion of the solar heat and prevent its reaching the ground; while the latter, by its evaporation from the land surface, will still further reduce the temperature. The annual curves of temperature at the Bengal stations show most strikingly how the temperature falls with cloud and rain. A single heavy storm without any change in the prevalent wind direction reduces the temperature by several degrees for two or three days after the fall; and the same fact is illustrated in the mean annual curve, which falls considerably on the setting in of the rains, while there is generally a slight rise in September when the rains draw to a close. It follows, then, that the whole increase of the sun's heat and something more, in the tropics, is absorbed in evaporation and by the upper strata of the atmosphere, thus affording a confirmation of the speculation of (I think) Sir John Herschel, that the inferior planets (if partly covered by water) may enjoy an equable moderate temperature fitted for the existence of such terrestrial organisms as can thrive under a sombre sky.

June 7 H. F. BLANFORD

SCIENCE IN GERMANY

(*From a German Correspondent.*)

BUNSEN'S ice-calorimeter was used lately for a very interesting experiment by Messrs. Röntgen and Exner, who tried to determine the intensity of the radiation of the sun by means of an apparatus constructed on the principle of that calorimeter. The apparatus consists of a glass bell *a* of 75 mm. height. This is fastened into a brass hoop *b*, which is closed below by a plate of wrought silver of $\frac{1}{4}$ mm. thickness, and 106 mm. diameter. The neck of the bell bears a massive brass top *d*, which is cut conically above and below, and has a central opening of 6 mm. diameter. Into the exterior groove a massive brass cone *e* fits water-tight, having also the central boring, into which a little glass tube is fastened. By a screw *h* in the circumference, the cone *e* can be firmly pressed against the brass piece *d*, while the tube *f* communicates with the interior of the bell *a*. A second communication between the interior of the bell and the



outside is obtained by the boring at *g* and the metal-tube *i*, with stopcock *l*.

When the apparatus is to be used as a pyrheliometer, the bell is filled with well-boiled distilled water, and the whole is frozen like one of Bunsen's calorimeters. To the tube *f* a long glass tube of perfect calibre and with millimetre divisions is fastened by means of a piece of india-rubber tubing; to the end *k* of the brass tube with stopcock an indiarubber ball filled with well-boiled water is then fastened, the stopcock opened, and while the apparatus is held vertically, all air which may still be contained in the bell is removed from it through the cone *e*, the tube *f*, and the divided tube, so that the latter is filled with water up to its end. Then the stopcock *l* is closed. If beforehand the silver plate has been carefully covered with soot, the apparatus is ready for use. It is directed towards the sun just like Pouillet's pyrheliometer, so that the sun's rays fall vertically upon the blackened plate. The divided tube is then supported as much as possible in a horizontal position, and the progress of the column of water in the same is observed with a second clock from minute to minute. This progress of the